## REMARKS

By the present amendment, claims 1 to 3 are under consideration in the application.

**Restriction Requirement**

Claims 4 to 7 have been withdrawn from consideration as being non-elected claims in the response to the restriction requirement.

Withdrawn dependent claim 4 has been amended to make clear that dependent claim 4 incorporates by reference all the limitations of independent claim 1.

Claims 4 to 7 are each dependent, directly or indirectly, from independent claim 1. If independent claim 1 is found to be allowable, it is respectfully requested that the restriction requirement with respect to dependent claims 4 to 7 be withdrawn. The applicants are entitled to a reasonable number of dependent claims.

**§112, ¶2**

Claims 1 to 3 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

In response to this rejection, claim 1 has been amended by the present amendment taking into account the comments in the Office Action.

In view of the present amendment, it is respectfully requested that the rejections under 35 U.S.C. §112, second paragraph, be withdrawn.

**§102/§103**

Claims 1 to 3 were rejected under 35 U.S.C. §102(b) as being anticipated by Japan No. 2000-290730 to Suzuki et al. ("JP '730").

Claim 3 was rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 2000-290730 to Suzuki et al. in view of Japan No. 2003-005751 to Fujita et al. ("JP '751").

These rejections are respectfully traversed.

**The Present Invention**

The present invention provides a high strength, alloyed molten zinc plated steel sheet able to be utilized as a member of an automobile, building material or electrical appliances. The alloyed molten zinc plated steel sheet containing the specific compositions and comprising a complex microstructure composed of a ferrite, bainite and residual austenite phases has on its surface a Zn alloy plating layer comprised of Fe in a concentration of 7 - 15 wt%, Al in a concentration of 0.01 - 1 wt%, and the balance Zn and unavoidable impurities.

The plating layer contains oxide particles of at least one of Al oxide, Si oxide, Mn oxide, Al and Si complex oxide, Al and Mn complex oxide, Si and Mn complex oxide, and Al, Si, and Mn complex oxide alone or in combination. An average diameter of the particle size of the oxides is 0.01 - 1 μm, and having a density of the particles of $1 \times 10^8$ particles/cm$^2$ - $1 \times 10^{11}$ particles/cm$^2$ for promoting alloying of the plated layer and obtaining uniform alloying layer, as shown in Fig. 1 of Attachment A hereto.

**Patentability**

The technology disclosed in JP '730 relates to a high strength hot-dip galvanized steel sheet excellent in balance of strength and ductility, where a hot-rolled steel sheet containing the specified component compositions is heated at 800 - 1000°C for 10 - 120 seconds and then cooled to 300°C at a cooling rate of more than 40°C/sec, and after that the surface of the steel sheet is pickled under the condition of a 0.05 - 5 g/m$^2$ pickling loss expressed in terms of Fe, then a continuous hot-dip galvanizing with a heating step at a temperature of 725 - 840°C for 5 - 200 sec., a cooling step to below 600°C at a cooling rate of 2 - 50°C/sec, and a plating step. As disclosed in the JP '730, it is necessary to apply an internal oxide layer of several microns on the surface of the steel sheet as mentioned and shown in [0017] and Fig. 4 of JP '730.

On the other hand, the present invention defines a density of the oxide particles of less than 1 x $10^{11}$ particles/$cm^2$ for avoiding peeling off of the plating layer caused by the excessive amount of oxide formation. See specification page 14, lines 11 to 13. Regarding the average diameter of the oxide particles, the present invention defines more than 0.01 μm and less than 1 μm which is quite different from the internal oxide layer having a thickness of about several microns defined in the '730 patent, because if the average diameter of the oxide particle exceeds 1 μm, cracks occur and corrosion resistance at the fabricated portion deteriorates, as mentioned on page 13 of the specification.

If "the internal oxide layer having several microns on the surface of the steel sheet" defined in JP '730 is converted to the average diameter of the oxide particles according to the present invention using the measurement of the average grain diameter method, average oxide diameter is definitely over more than 1 μm. Therefore, the oxide particles defined in the present invention are quite different from the internal oxide layer of JP '730.

To repeat, "the internal oxide layer having several micron" in JP '730 clearly causes cracks. This difference is caused by a different production process, where an atmosphere pressure condition, heating condition during the continuous annealing step mentioned in [0017] - [0019] in JP '730, and those conditions defined in the present invention, as shown in Fig. 2 of Attachment A hereto. Further, the object of the formation of the internal oxide layer in JP '730 restrains a diffusion of solute Si, Mn contained in the internal oxide layer to the surface of the base steel sheet. However, a diffusion of solute Si, Mn can be restrained in the present invention because of the small average diameter of the oxide particle. Therefore, the present invention is quite different from the technology disclosed in the JP '730.

Further, in JP '730, the oxygen potential of the annealing atmosphere in a continuous hot-dip galvanizing line (CGL) determines the condition of a reduction of P oxide as mentioned in [0019] and defines the upper limit of Line 5 in Fig. 2 of Attachment A. On the other hand, the $H_2O/PH_2$ ratio during heating in the present invention is carried out in the ranges between Curve 1 and Curve 2 of Fig. 2 of Attachment A for formation of the internal oxide particles as mentioned on page 14 and page 15 of the specification. If the $H_2O/PH_2$ area is above Curve 2, Fe oxide is formed and causes inferior plating (as mentioned on page 15), and cannot form the internal oxides having an average diameter of less than 1 μm, as shown in the attached Fig. 2.

Although JP '730 further describes a pickling step after continuous annealing in [0042] - [0043], the present invention does not need pickling and continuous annealing. In addition, the heating conditions during hot-dip continuous galvanizing mentioned in [0044] - [0047] in JP '730 is not a novel feature because such a condition is a common step for the production of a high strength hot-dip galvanizing steel sheet. The description [0049] - [0050] in JP '730 is the same as above.

In a conventional continuous molten zinc plating step, a heat treatment step for forming the internal oxide layer, and a pickling treatment step are required, so there was the problem that a rise in production costs was invited. JP '730 solved this problem by means of continuous annealing step for forming the required internal oxide layer to improve platability.

However, the production process according to the present invention is characterized by making the heating temperature T at a recrystallization annealing step in a reducing furnace of a continuous molten zinc plating system 650°C to 900°C, passing a steel sheet through an atmosphere where a ratio $PH_2O/PH_2$ of the steam partial pressure $PH_2O$ and the hydrogen partial pressure $PH_2$ of the atmosphere of the reducing furnace is in the

specified conditions claimed in claim 4, for forming internal oxide at a region from the surface of the steel sheet to a depth of 1.0 μm, then successively performing molten zinc plating treatment and alloying treatment. JP '730 does not disclose or suggest the above-mentioned characteristic feature of the present invention.

Further, Expression (2) defined in [0047] of JP '730 is thermodynamically conducted by a free energy during P oxide formation. On the other hand, the Expression of oxygen potential is conducted from the condition of the oxide formation based on the velocity theory. This means that the technical idea is quite different. Therefore, JP '730 patent is different from the present invention.

The technology disclosed in JP2003-55751 (JP '751) relates to a high strength, hot-dip galvanized steel sheet with a plated layer having a composition containing 0.001 - 0.5% Al, 0.001 - 2% Mn and 5 - 20% Fe and the balance Zn, and X (%) of Si, Y (%) of Mn, Z (%) of Al in the steel sheet, and A (%) of Al, B (%) of Mn in the plated layer satisfy the specified Expression, and the microstructure of the steel sheet is by volume fraction, 70 - 97% ferrite having a mean grain diameter of 220 μm and 3 - 30% austenite and/or martensite having a mean grain diameter of 210 μm.

As mentioned in [0017] of the '751 patent, it is necessary to restrain a generation of inferior plating by means of the addition of the specific element removing the bad influence of Al contained in the Zn bath. This problem is solved by the specified Expression by means of multiple regression analysis considering steel and plating compositions affecting wettability. Basically, this problem is solved by the added Mn in the plating bath increasing reactability with the Si oxide layer formed on the surface of the steel sheet.

On the other hand, a plating layer, according to the present invention, contains oxide particles of at least one of Al oxide, Si oxide, Mn oxide, Al and Si complex oxide, Al

and Mn complex oxide, Si and Mn complex oxide, and Al, Si, and Mn complex oxide alone or in combination, where the average diameter of the particle size of the oxide is 0.01 - 1 μm, and having a specific density of the particles for promoting alloying of the Fe and Zn by oxide particles in the plating layer, with uniform alloying occurring across the entire surface of the steel sheet, and making the parts where the Fe-Zn alloy phase is not formed become less than 10% of the area of the steel sheet as a whole. This is carried out by means of controlling the steam pressure of the reducing furnace atmosphere. These characteristic features of the present invention are not disclosed or suggested in the '751 patent.

It is therefore submitted that claims 1 to 3 are patentable over Japan No. 2000-290730 alone or in combination with Japan No. 2003-005751.



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## CONCLUSION

It is submitted that in view of the present amendment and the foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application be allowed and passed for issue.

Respectfully submitted,

KENYON & KENYON

By: John J. Kelly, Jr.
John J. Kelly, Jr.
Reg. No. 29,182

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KENYON & KENYON
One Broadway
New York, NY 10004
Telephone No. (212) 425-7200
Facsimile No. (212) 425-5288
**CUSTOMER NO. 26646**